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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
10/722,179	11/25/2003	Kamal Kishore Goundar	ASMJP.133CP1	7004
20995	7590	01/03/2005	EXAMINER	
KNOBBE MARTENS OLSON & BEAR LLP			ANYA, IGWE U	
2040 MAIN STREET			ART UNIT	
FOURTEENTH FLOOR			PAPER NUMBER	
IRVINE, CA 92614			2825	

DATE MAILED: 01/03/2005

Please find below and/or attached an Office communication concerning this application or proceeding.

Office Action Summary

Application No.

10/722,179

Applicant(s)

GOUNDAR ET AL.

Examiner

Igwe U. Anya

Art Unit

2825

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

- 1) ☒ Responsive to communication(s) filed on 25 November 2003.
- 2a) ☐ This action is **FINAL**. 2b) ☒ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

- 4) ☒ Claim(s) 1-41 is/are pending in the application.
- 4a) Of the above claim(s) _____ is/are withdrawn from consideration.
- 5) ☐ Claim(s) _____ is/are allowed.
- 6) ☒ Claim(s) 1,3-5,7,9-11,13-18,22-26 and 30-41 is/are rejected.
- 7) ☒ Claim(s) 2,6,8,12,19-21 and 27-29 is/are objected to.
- 8) ☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

- 9) ☐ The specification is objected to by the Examiner.
- 10) ☒ The drawing(s) filed on 25 November 2004 is/are: a) ☒ accepted or b) ☐ objected to by the Examiner.
Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).
Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).
- 11) ☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

- 12) ☒ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
- a) ☒ All b) ☐ Some * c) ☐ None of:
1. ☐ Certified copies of the priority documents have been received.
 2. ☒ Certified copies of the priority documents have been received in Application No. 10/682,180.
 3. ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

- | | |
|--|---|
| 1) <input checked="" type="checkbox"/> Notice of References Cited (PTO-892) | 4) <input type="checkbox"/> Interview Summary (PTO-413)
Paper No(s)/Mail Date. _____ |
| 2) <input type="checkbox"/> Notice of Draftsperson's Patent Drawing Review (PTO-948) | 5) <input type="checkbox"/> Notice of Informal Patent Application (PTO-152) |
| 3) <input checked="" type="checkbox"/> Information Disclosure Statement(s) (PTO-1449 or PTO/SB/08)
Paper No(s)/Mail Date <u>11/25/03, 11/2/04</u> . | 6) <input type="checkbox"/> Other: _____ |

DETAILED ACTION

Claim Rejections - 35 USC § 103

1. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

2. This application currently names joint inventors. In considering patentability of the claims under 35 U.S.C. 103(a), the examiner presumes that the subject matter of the various claims was commonly owned at the time any inventions covered therein were made absent any evidence to the contrary. Applicant is advised of the obligation under 37 CFR 1.56 to point out the inventor and invention dates of each claim that was not commonly owned at the time a later invention was made in order for the examiner to consider the applicability of 35 U.S.C. 103(c) and potential 35 U.S.C. 102(e), (f) or (g) prior art under 35 U.S.C. 103(a).

3. Claims 1, 4, 5, 7, 9, 10, 11, 13 – 18, 22 – 26, 30 – 31 and 33 – 35 are rejected under 35 U.S.C. 103(a) as being unpatentable over Xu et al. (USPAB 2003/0194496) in view of Zheng et al. (USPAB 2004/0067308).

4. Xu et al. teach a method for forming a silicon carbide film on a semiconductor substrate by plasma CVD, comprising the steps of:

introducing a raw material gas containing silicon, carbon, and hydrogen (trimethylsilane, 10 – 1500 mgm), hydrogen (10 – 2000 sccm), and an a noble gas (1 – 1000 sccm) into a reaction chamber at a predetermined mixture ratio (paragraph 22);

applying radio-frequency power to a reaction zone inside the reaction chamber at the mixture ratio (paragraph 23), thereby forming on a semiconductor substrate a curable silicon carbide film having a dielectric constant of about 3.5 – 4.5 (paragraph 24);

applying radio-frequency power to the reaction zone at a mixture ratio which is reduced (*absence of raw material gas, hence zero ratio to inert gas*) from that of the previous step, thereby curing the silicon carbide film to give a dielectric constant lower than that of the curable silicon carbide film (paragraphs 57 – 61);

the radio-frequency power comprises of a low frequency power and a high-frequency power, the low frequency power having a frequency of less than 2 MHz and high frequency power having a frequency of no less than 2 MHz (paragraph 23);

the silicon carbide film is an etch stop film (paragraph 13), the silicon carbide curing time period ranges from 2 seconds – 60 minutes (paragraphs 53 – 55), and the mixture ratio is constant before and after a point where the mixture ratio is discontinuously reduced (paragraphs 24 & 55);

a curing period of 10 – 100 seconds (paragraph 59); and

the mixture ratio of the raw material and the noble gas before the reduction is about 1/1 to 1/3 (paragraph 63).

5. Xu et al. lack deposition of the film and curing of the film as a continuous step.
6. However, Zheng et al. the deposition of the film and curing of the film as a continuous step (in situ: paragraph 58) to prevent exposure to oxidizing ambient.

7. Therefore, it would have been obvious to one of ordinary skill in the art at the time the invention was made to incorporate the teachings of Zheng et al. and make a sequential deposition of a film and curing of the film as a continuous step to reduce process steps and prevent exposure to an oxidizing ambient. Furthermore, making two sequential steps into one continuous step that does not produce any new or unexpected result involves routine skill in the art.

8. Claim 32 is rejected under 35 U.S.C. 103(a) as being unpatentable over Xu et al. (USPAB 2003/0194496) in view of Zheng et al. (USPAB 2004/0067308), and further in view of Nemani et al. (US Patent 6764958).

9. Xu/Zheng et al. teaches the features previously outlined, but lack the low frequency power being less than half the total power.

10. However, Nemani et al. teach the low frequency power being less than half the total power (col. 5 lines 6 – 22) to optimize film deposition.

11. Therefore, it would have been obvious to one of ordinary skill in the art at the time the invention was made to incorporate the teachings of Nemani et al. into Xu/Zheng et al. for optimization.

12. Claims 3, 36 – 41 are rejected under 35 U.S.C. 103(a) as being unpatentable over Xu et al. (USPAB 2003/0194496) in view of Zheng et al. (USPAB 2004/0067308), and further in view of Grill et al. (US Patent 6147009).

13. The Xu/Zheng et al. reference teaches the features previously outlined, but lacks:

an interconnect of copper wiring comprising forming a silicon carbide film as an etch stop layer on a dielectric film and etching the substrate, wherein the dielectric film is made of a Si-C-O-H material, and etch stop layer is made of a Si-C-H material;

depositing a silicon carbide film on the top of a multi layer film wherein copper is covered by silicon carbide; and

the multi layer comprises of a lower etch stop layer, a lower low dielectric layer, an intermediate etch stop layer, an upper low dielectric layer, an upper etch stop dielectric layer, and a resist layer laminated in sequence.

14. However, Grill et al. teach:

an interconnect (figs. 6 – 9) of copper wiring (col. 7 lines 58 – 59) comprising forming a silicon carbide film as an etch stop layer on a dielectric film and etching the substrate, wherein the dielectric film is made of a Si-C-O-H (38, 44, & col. 8 lines 27 – 33) material, and etch stop layer is made of a Si-C-H material (74, col. 8 lines 33 – 44);

depositing a silicon carbide film (44) on the top of a multi layer film where copper (40) is covered by silicon carbide (col. 7 lines 40 – 61); and

the multi layer comprises (fig. 9) of a lower etch stop layer (62), a lower low dielectric layer (84), an intermediate etch stop layer (82), an upper low dielectric layer (86), an upper etch stop dielectric layer (74), and a resist (inherent with photolithography, also see Zheng et al. paragraph 64 & figs. 1 – 2H) laminated in sequence.

15. Therefore, it would have been obvious to one of ordinary skill in the art at the time the invention was made to incorporate the teachings of Grill et al. into the Xu/Zheng et al. reference to form a BEOL with thermally stable low K dielectric.

16. Claims 2, 6, 8, 12, 19 – 21, and 27 – 29 are objected to as being dependent upon a rejected base claim, but would be allowable if rewritten in independent form including all of the limitations of the base claim and any intervening claims.

17. Prior art considered, but not used in the rejection include Grill et al. (US Patent 6312793), and Tang et al. (USPAB 2004/0126929), Nemani et al. (US Patent 6589888), Li et al. (US Patent 6790788), Bencher et al. (US Patent 6635583), and Xu et al. (US Patent 6656837).

18. Any inquiry concerning this communication or earlier communications from the examiner should be directed to Igwe U. Anya whose telephone number is (571) 272-1887. The examiner can normally be reached on M - F 8:30am - 5:00pm.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Matthew S. Smith can be reached on (571) 272-1907. The fax phone number for the organization where this application or proceeding is assigned is 703-872-9306.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see <http://pair-direct.uspto.gov>. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free).

Igwe U. Anya
Examiner
Art Unit 2825

IA

December 20, 2004.

